REVIEW OF CHINESE SPECIES OF GENUS *EULOPHUS* (HYMENOPTERA: EULOPHIDAE)[1]

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ABSTRACT: This paper treats the Chinese species of *Eulophus*. Five species of *Eulophus*, *E. cyanescens*, *E. smerinthicida*, *E. abdominalis*, *E. ramicornis*, and *E. pennicornis* have been recorded as new to China. We also include the following species in the key to species based on Bouček's description for their distinct characters: *E. thespius*, *E. slovacus*. With intensive comparative morphological study under scanning electronic microscopy (SEM), we provided comments on relationships between *Eulophus* and other possibly related genera in Eulophinae.

Eulophus Geoffroy is one of the oldest names in Chalcidoidea. Bouček (1959) discussed the origin of the name and gave a key to species of central Europe. In China, only *E. larvarum* (Linnaeus) was recorded by Liao (1987), however this species is actually *E. ramicornis* (Fabricius) (Graham 1988).

Around 66 species of *Eulophus* have been reported worldwide (Table 1 – digested from Noyes 1998). One species was described or reported from Afrotropical Senegal, one from Hawaii, eleven from Canada or the USA (including two also from the Palearctic regions), one from Neotropical Brazil, two from Oriental regions of Indonesia and Sri Lanka, and fifty-one from the Palearctic regions (Table 1). More extensive research on *Eulophus* has been carried out in the Palearctic and Nearctic regions. As China spans both Palearctic and Oriental regions, several species of *Eulophus* would be expected to be found there.

In this paper, we examined all specimens in collections in China and two determined specimens from outside of China. *Eulophus cyanescens* Bouček, *E. smerinthicida* Bouček, *E. abdominalis* Nees, *E. ramicornis* (Fabricius) and *E. pennicornis* Nees have been newly recorded from China. We also included the following species in the key to species basing on Bouček's description for their distinct characters: *E. thespius* Walker, *E. slovacus* Bouček.

In China, several genera of Eulophinae are characterized by having the funicle 3-segmented and notauli incomplete. They are *Dicladocerus* Westwood, *Colpoclypeus* Lucchese, *Eulophus* Geoffroy and *Necremnus* Thomson. *Eulophus* is distinguished from all others by having 1) reduced mandibles with teeth not reaching each other medially; 2) basitarsus (at least of mesotarsus) distinctly shorter than second tarsal segment (Bouček 1959, Peck et al. 1964, Schauff et al. 1997). Some other genera, for example, *Pnigalio* Schrank, *Hemiptarsenus* Westwood, *Dimmockia* Ashmead, *Notanisomorphella* Girault, and *Sympiesis* Förster, are sometimes considered closely related to *Eulophus*,

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although members of those genera nearly always have a 4-segmented funicle (Fig. 2), longer basitarsus and normal mandibles. Before this project, little work has been done to work out the relationships among genera mentioned above.

The purposes of this paper are to: 1) report and review species of *Eulophus* occurring in China; 2) provide new host records, new distributional records, and associated plants for some species; 3) carry out extensive SEM study of selected species of genera probably close to *Eulophus*; 4) find out more external morphological characters, if available, to clarify the definition of *Eulophus*; 5) try to find possible relationships between *Eulophus* and other genera in Eulophinae.

MATERIAL AND METHODS

Depositories. – This study is based on specimens deposited in the following collections: 1) Institute of Zoology, Chinese Academy of Sciences (IZCAS); 2) the Natural History Museum, London, UK (BMNH); 3) Insect Collection, Taiwan Agricultural Research Institute (TARI); 4) Systematic Entomology, Faculty of Agriculture, Hokkaido University (SEHU).

Terminology and measurements. – Morphological terms follow Gibson et al. (1997). Absolute measurements, in millimeters (mm) are used for the body and forewing length. For all other dimensions, relative measurements are used.

SYSTEMATICS

FAMILY EULOPHIDAE

Genus Eulophus Geoffroy

Eulophus Geoffroy, 1762: 312. Type species *Ichneumon ramicornis* Fabricius; original designation by monotypy.

Comedo Schrank, 1802: 308. Type species *Ichneumon larvarum* Linnaeus; designated by monotypy. Validated by Crawford, 1912: 186; Girault, 1920: 201. Synonymized by Peck, 1951: 430.

Cratotechus Thomson, 1878: 219. Type species *Ichneumon larvarum* Linnaeus; designated by Ashmead 1904. Synonymized by Bouček et Askew, 1963: 60.

Onychocomedo Graham, 1959: 183. Type species *Eulophus thespius* Walker; designated by Graham, 1959. Synonymized by Bouc-ek, 1959: 160.

Diagnosis. - Funicle 3-segmented. Mandibles reduced, with teeth not reaching each other medially. Basitarsus, at least of mid legs, shorter than the second. Notauli incomplete, not reaching posterior margin of mesoscutum. Pupae gregarious on leaves.

Remarks. - In previous keys to Palearctic genera of Eulophinae (Bouček 1959, Peck et al.1964), *Eulophus* is grouped with *Dimmockia*, *Pnigalio*, *Sympiesis*, *Dicladocerus*, *Microlycus*, and *Necremnus*. However, no charac-

ters seem to support any relationships between *Eulophus* and any other genera. Several keys including Schauff et al. 's (1997) seem to show closer relationships between *Eulophus* and *Necremnus*, for both genera are similar in having: 1) notauli incomplete, not reaching posterior margin of mesoscutum; 2) scutellum with paired setae; 3) funicle 3-segmented; 4) scutellum without submedian grooves (Fig. 5); 5) clypeus entire; 6) male funicle with elongate branches. These latter two genera can be separated by the mandibular and tarsal characters given in the diagnosis.

Biology. - Parasitoids of Agonoxenidae, Coleophoridae, Gelechiidae, Gracillariidae, Lymantriidae, Lyonetiidae, Noctuidae, Oecophoridae, Plutellidae, Pyralidae, Tortricidae, Tischeriidae [Lepidoptera] (Thompson 1955, Decelle 1962, Herting 1975, 1977, Graham 1991, Cossentine et Jensen 1992); Ichneumonidae, Tenthredinidae [Hymenoptera] (Thompson 1955, Herting 1977); Tephritidae, Agromyzidae [Diptera] (Thompson 1955); and Chrysomelidae, Curculionidae [Coleoptera] (Thompson 1955). Kamijo (1986) reported some *Pediobius* spp. as parasitoids of *Eulophus* sp.

Distribution. - Worldwide.

KEY TO SPECIES OF *Eulophus* IN CHINA

1 Scutellum, axilla, and dorsellum with engraved reticulation; thorax with more or less golden shine 2
- Scutellum, axilla, or dorsellum with raised reticulation; thorax without golden shine 3
2 Plica at most shortly indicated ..... *E. smerinthicida* Bouček (examined)
- Plica distinct and strong, reaching at least 4/5 from posterior margin of propodeum to spiracle (Fig. 5) ..... Chinese *E. smerinthicida*
3 Forewing densely hairy, with speculum reduced; basal vein and cubital vein more or less present around speculum; flagellum of female black, dilated, distal corner of funicles sharply angular ..... *E. pennicornis* Nees
- Forewing sparsely hairy, with speculum larger; basal vein or cubital vein glabrous; flagellum slender 4
4 Last tergite with a bunch of black spines on either side dorsally ..... *E. thespius* Walker (examined)
- Last tergite without spines 5
5 Scutellum strongly convex; propodeum with short but distinct neck ..... *E. abdominalis* Nees
- Scutellum more or less feebly convex; propodeum with indistinct neck 6
6 Femora mainly metallic; forewing with a slightly square fuscous cloud in the middle ..... *E. slovacus* Bouček (examined)
- Femora without metallic shine; forewing without fuscous cloud in the middle 7
7 Tarsal segment IV subequal to II plus III; plica distinct in at least posterior half of propodeum ..... *E. cyanescens* Bouček
- Tarsal segment IV barely longer than II; plica indistinct ..... *E. ramicornis* (Fabricius)

E. abdominalis Nees

Eulophus abdominalis Nees, 1834: 159. Transferred into Comedo by Graham, 1959: 183. Lectotype designated by Graham 1988: 26.
Eulophus anatole Walker, 1839: 126. Synonymized by Graham, 1959: 183.

Cratotechus longicornis Thomson, 1878: 221. Lectotype designated by Hansson, 1991: 32. Synonymized by Bouček, 1959: 164.

Diagnosis. - Scutellum strongly convex; propodeum with short but with distinct neck; last tergite of gaster without spines; forewing sparsely hairy, with distinct speculum; basal vein or cubital vein glabrous; flagellum slender.

Material examined. - All deposited in IZCAS, except otherwise stated in the brackets: 10 ♀, Hebei, Qing Xian, 27/VII/1963(LIAO Ding-xi); 1 ♀, Jiangsu, Nanjing, Linggu Temple, 10/IX/1997(ZHU Chao-dong); 1 ♀, Henan, Songxian, Baiyunshan, 18/VII/1996(XIAO Hui); 1 ♀, Henan, Songxian, Baiyunshan, 15/VII/1996, 1700 M(XIAO Hui); 1 ♀, Hunan, Yongshun, 5/VIII/1988, 650 M(YANG Long-long); 1 ♀, Hubei, Badong, 12/VIII/1989, 1500 M(HUANG Da-wei); 1 ♀, Hubei, Lichuan, Xingdoushan, 21/VII/1989, 800 M(HUANG Da-wei); 1 ♀, Hubei, Lichuan, Xingdoushan, 25/VII/1989, 900 M(HUANG Da-wei); 2 ♀, Jiangxi, VII/1979, ex. *Eurhodope pirivorella* Matsumura [Pyralidae]; 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 15/VII/1982, 2150 M(LIH SC. & LIN CN) (TARI); 1 ♀, 4 ♀, C. Taiwan, Nantou Xian, Tungpu, 20-24/VI/1983, 1200 M(CHOU KC. & WONG CY) (TARI); 2 ♀, 16 ♀, C. Taiwan, Nantou Xian, Tungpu, 18-23/XI/1981, 1200 M(LIN T. & TANG WS) (TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 30/VII/1983, 2150 M(CHOU LY) (TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 22-26/VI/1983, 2150 M(LIN KS. & LIN SC) (TARI); 3 ♀, C. Taiwan, Nantou Xian, Meifeng, 5-9/X/1980, 2150 M(CHEN CC. & CHIEN CC) (TARI); 5 ♀, C. Taiwan, Nantou Xian, Meifeng, 26/VIII/1980, 2150 M(LIN KS. & WANG CH) (TARI); 5 ♀, Guizhou, Guiyang, Huaxi, 11/X/1983(LI Chang-fang); 1 ♀, Guizhou, Guiyang, Huaxi, 9/X/1983(LI Chang-fang); 1 ♀, Yunnan, Dieqing Zhou, Congjianghe, 8/VIII/1983, 2800 M(LI Chang-fang); 1 ♀, Yunnan, Lanping, Jinding, 24/VIII/1984, 2300 M(LI Chang-fang); 1 ♀, Yunnan, Zhanyi Xian, 19/IV/1957(LIAO Ding-xi).

Biology. - Larval parasitoid of Geometridae, Lasiocampidae, Lymantriidae, Notodontidae, Noctuidae, Tortricidae [Lepidoptera] (Thompson 1955, Bouček et Askew 1968, Herting 1976, Trjapitzin 1978). Newly recorded as parasitoid of *Eurhodope pirivorella* Matsumura [Pyralidae].

Distribution. - Hebei, Jiangsu, Henan, Hunan, Hubei, Jiangxi, Taiwan, Guizhou, Yunnan. Palearctic region.

E. cyanescens Bouček

E. cyanescens Bouček, 1959: 166. By original designation.

Diagnosis. - Tarsomere IV subequal to II plus III; plica distinct in at least posterior half of propodeum; femur without metallic shine; forewing without fuscous cloud in the middle; scutellum more or less feebly convex; propodeum with indistinct neck; last tergite of gaster without spines; forewing sparsely hairy, with speculum larger; basal vein and cubital vein glabrous; flagellum slender; scutellum, axilla, and dorsellum with raised reticulation; thorax without golden shine.

Material examined. - All deposited in IZCAS, except otherwise stated in brackets: 3 ♀, Beijing, 31/VIII/1972(CAI Rong-quan); 1 ♀, 3 ♀, Helongjiang, Yichun, Dailing, 29/VI/1962, ex. *Lymantria dispar;* 1 ♀, Fujian, Cong'an, Guadun, 23/VI/1980(ZHAO Xiu-fu); 1 ♀, Hubei, Xuan'en, 5/VIII/1989, 1000 M(HUANG Da-wei); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 26/VIII/1980, 2150 M(LIN KS. & WANG CH)(TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 19-21/IV/1983, 2150 M (CHOU KC. & HUANG SP) (TARI); 11 ♀, C. Taiwan, Nantou Xian, Meifeng, 2-4/VI/1980, 2150 M (CHOU LY. & CHEN CC) (TARI); 4 ♀, C. Taiwan, Nantou Xian, Meifeng, 5-9/X/1980, 2150 M (CHEN CC. & CHIEN CC) (TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 7-9/V/1981, 2150 M (LIN KS. & LIN SC) (TARI); 1 ♀, Sichuan, E'mei Shan, 18/VI/1955(HUANG Ke-ren & IN Geng-tao); 1 ♀, Yunnan, Lijiang Diqu, Baishui, 17/VII/1984, 2850 M(LI Chang-fang); 1 ♀, Yunnan, Lijiang Diqu, Baishui, 19/VII/1984, 3000 M (LI Chang-fang); 1 ♀, Yunnan, Lijiang Diqu, Ludian, VIII/1984, 3200 M(LI Chang-fang).

Biology. - Parasitoid of *Lithophane ornitopus* (Noctuidae) [Lepidoptera] (Bouček 1959). Newly recorded as parasitoid of *Lymantria dispar* (Lymantriidae).

Distribution. - CHINA: Beijing, Heilongjiang, Fujian, Hubei, Taiwan, Sichuan, Yunnan. Palearctic region.

E. ramicornis (Fabricius)

Ichneumon ramicornis Fabricius, 1781: 441. Transferred into *Eulophus* by Olivier, 1792: 454; into *Diplolepis* by Fabricius, 1804: 153; into *Cynips* by Latreille, 1805: 224; into *Chalcis* by Jurine, 1807: 316; into *Entedon* by Dalman, 1820: 173. Synonymized by Bouček, 1959: 167.

Cratotechus hoplitis Crawford, 1911: 622. Lectotype designated by Kamijo, 1976: 490. Transferred into *Eulophus* by Bouček et Askew, 1968: 62. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Cynips eulophus Fourcroy, 1785: 389. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26; Graham, 1994: 126.

Eulophus bombycicornis Ratzeburg, 1844: 161. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus damicornis Förster, 1841: 42. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus dimidiatus Nees, 1834: 160. Transferred into *Elachertus* by Walker, 1846: 68. Lectotype designated and synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus fumatus Ratzeburg, 1848: 156. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus mulierosus Karsch, 1879: 31. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus nigribasis Gradwell, 1957: 140. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Eulophus phalaenarum Ratzeburg, 1844: 166. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Ichneumon myriventris Retzius, 1783: 70. Synonymized as *Ichneumon ramicornis* Fabricius by Graham, 1988: 26.

Diagnosis. - Tarsal segment IV barely longer than II; plica indistinct; femur without metallic shine; forewing sparsely hairy, with speculum larger, basal vein and cubial vein glabrous, without fuscous cloud in middle; scutellum more or less feebly convex; propodeum with indistinct neck; last tergite

of gaster without spines; flagellum slender; scutellum, axilla, and dorsellum with raised reticulation; thorax without golden shine.

Material examined. - All deposited in IZCAS, except otherwise stated in the brackets: 18 ♀, Beijing, Qinglong Bridge, 8/VII/1955(LIAO Ding-xi); 1 ♀, Beijing, 31/VIII/1972(CAI Rong-quan); 3 ♀, Beijing, Badaling, 29/VIII/1975, ex. *Lymantria* sp.(WANG Jin-long); 1 ♀, Hebei, Xinglong Xian, 23/VII/1985, 1800-1900 M(MI Hua-shi); 1 ♀, Jilin, University of Agriculture, VIII/1979(ZHANG Zuo); 1 ♀, Jilin, Gongzhuling, 25/V/1957(CHEN Tai-lu); 1 ♀, Helongjiang, Daxinganling, Institute of Forestry, 26/VI/1981(LI Shu-sheng); 1 ♀, Shandong, Wendeng Xian, Wuran Temple(HOU Zao-jin); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 15/VII/1982, 2150 M(LIN SC. & LIN CN)(TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 4-7/X/1982, 2150 M(CHOU KC) (TARI); 2 ♀, C. Taiwan, Nantou Xian, Meifeng, 5-9/X/1980, 2150 M(CHEN CC. & CHIEN CC) (TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 22-26/VI/1982(LIN KS. & LIN SC) (TARI); 1 ♀, C. Taiwan, Nantou Xian, Meifeng, 26/VIII/1980, 2150 M(LIN KS. & WANG CH) (TARI); 2 ♀, Yunnan, Lijiang Diqu, Ludian, Machang, VIII/1984, 3200 M(LI Chang-fang); 1 ♀, Yunnan, Lanping, 22/VIII/1984, 2300 M(LI Chang-fang); 3 ♀, Shaanxi, Institute of Fruiter, VIII/1973.

Biology. - Parasitoid of Geometridae, Lasiocampidae, Lymantriidae, Noctuidae, Notodontidae, Oecophoridae, Pieridae, Sphingidae, Tortricidae [Lepidoptera] (Thompson 1955, Bouček et Askew 1968, Sechser 1970, Herting 1975, Herting 1976, Trjapitzin 1978, Kamijo 1979, Shaw 1979, 1981). Found to be parasitized by *Pediobius crassicornis* (Eulophidae) (Kamijo 1977).

Distribution. - CHINA: Beijing; Hebei, Jilin, Helongjiang, Shandong, Taiwan, Yunnan, Shaanxi. Palearctic region.

E. pennicornis Nees

Eulophus pennicornis Nees, 1834: 154. Transferred into *Comedo* by Graham, 1959: 183. Lectotype designated by Graham, 1988: 26.

Eulophus drupes Walker, 1839: 127. Synonymized by Graham, 1959: 183.

Eulophus fuliginosus Nees, 1834: 155. Synonymized by Bouček et Askew, 1968: 63.

Cratotechus opaculus Thomson, 1878: 221. Lectotype designated by Hansson, 1991: 32. Transferred into *Eulophus* by Gradwell, 1957: 141. Synonymized by Bouček, 1959: 163.

Entedon plumicornis Dalman, 1820: 181. Transferred into *Eulophus* by Curtis, 1829: 116. Synonymized by Bouček et Askew, 1968: 63.

Diagnosis. - Forewing densely hairy, with speculum reduced; basal vein and cubital vein more or less present around speculum; flagellum of ♀ black, dilated, distal corner of funicles sharply angular; scutellum, axilla, and dorsellum with engraved reticulation; thorax with more or less golden shine.

Material examined. - 2 ♀, Xinjiang Uygur Zizhiqu, Urumqi Shi, 15/VI/1991, ex. Monima incerta Hufnagel(LI Hui).

Biology. - Parasitoid of *Cecidomyiidae* (Bouček et Askew 1968); Noctuidae, Notodontidae [Lepidoptera] (Thompson 1955, Bouček et Askew 1968, Herting 1976, Trjapitzin 1978, Marris et Edwards 1994 & 1995, Marris *et al.* 1996, Weaver *et al.* 1997); Diprionidae [Hymenoptera] (Schwenke 1964).

Distribution. - CHINA: Xinjiang. Palearctic region.

E. smerinthicida Bouček

Eulophus smerinthicida Bouček, 1958: 164.

Diagnosis. - Plica distinct and strong, reaching at least 4/5 from posterior margin of propodeum to spiracle; scutellum, axilla, and dorsellum with engraved reticulation; thorax with more or less golden shine.

Chinese specimens differ from those from the Czech Republic in having stronger plica.

Material examined. - 5 ♀, Shanxi, Institute of Forestry, 24/VI/1980, ex. *Cerura menciana* Moore (YU Ci); 5 ♀, Inner Mongolia, Heling, 26/VI/1981, ex. *Cerura menciana* Moore (SHAO Qiang-hua); 2 ♀, Inner Mongolia, Heling, 9/IX/1980, ex. *Cerura menciana* Moore (SHAO Qiang-hua); 2 ♀, Inner Mongolia, Baotou, 24/VI/1989, ex. *Cerura menciana* Moore (LIU Zhong-ren); 2 ♀, Inner Mongolia, Baotou, 10/VII/1980, ex. *Cerura menciana* Moore (SHAO Qiang-hua); 1 ♀, Inner Mongolia, Wudangzhao, 10/VII/1980, ex. *Cerura menciana* Moore (SHAO Qiang-hua); 4 ♀, Liaoning, Shenyang, Institute of Gardening, ex. *Cerura menciana* Moore (XU Song-tian); 6 ♀, Liaoning, Liaoyang Shi Nursery, ex. *Cerura menciana* Moore (WEI Hua, ZHANG Gui-zhi, & ZHANG Yu-bao); 3 ♀, Liaoning, Liaoyang, Liuhe, 26/VIII/1979, ex. *Cerura menciana* Moore (ZHANG Yu-bao & ZHANG Gui-zhi); 44 ♀, Jilin, Changling Xian, 20/IX/1985, ex *Cerura menciana* Moore (ZHOU Feng-cheng); 1 ♀, Jilin, Da'an Xian, Anguang, 15/VII/1986, ex. *Cerura menciana* Moore (NIU Yu-zhi); 2 ♀, Jilin, Da'an Xian, Anguang, 19/VII/1986, ex. *Cerura menciana* Moore (NIU Yu-zhi); 4 ♀, Jilin, Da'an Xian, Anguang, VII/1986, ex. *Cerura menciana* Moore (NIU Yu-zhi); 2 ♀, Jilin, Da'an Xian, Anguang, 26/VII/1986, ex. *Cerura menciana* Moore (NIU Yu-zhi); 3 ♀, Jilin, Da'an Xian, Anguang, 22/VIII/1986, ex. *Cerura menciana* Moore (NIU Yu-zhi); 1 ♀, Jilin, Da'an Xian, 15/VIII/1986, ex.pupa of *Cerura menciana* Moore (ZHAO Ya-zhi); 3 ♀, Helongjiang, Heishan, Kangtun, ex. *Cerura* sp.; 3 ♀, Helongjiang, Heshan, Kangtun, 3/VIII/1977, ex. larva of *Cerura menciana* Moore; 1 ♀, Shaanxi, Wugong, IV/1963 (ZHOU Rao); 1 ♀, Ningxia Huizu Zizhiqu, College of Agriculture, VI/1979, ex. *Cerura menciana* Moore.

Biology. - Parasitoid of Noctuidae, Sphingidae, Geometridae [Lepidoptera] (Milicky 1963, Bouček et Askew 1968, Herting 1976, Trjapitzin 1978). Newly recorded from *Cerura menciana* Moore (Notodontidae) [Lepidoptera].

Distribution. - CHINA: Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shaanxi, Ningxia. Palearctic regions.

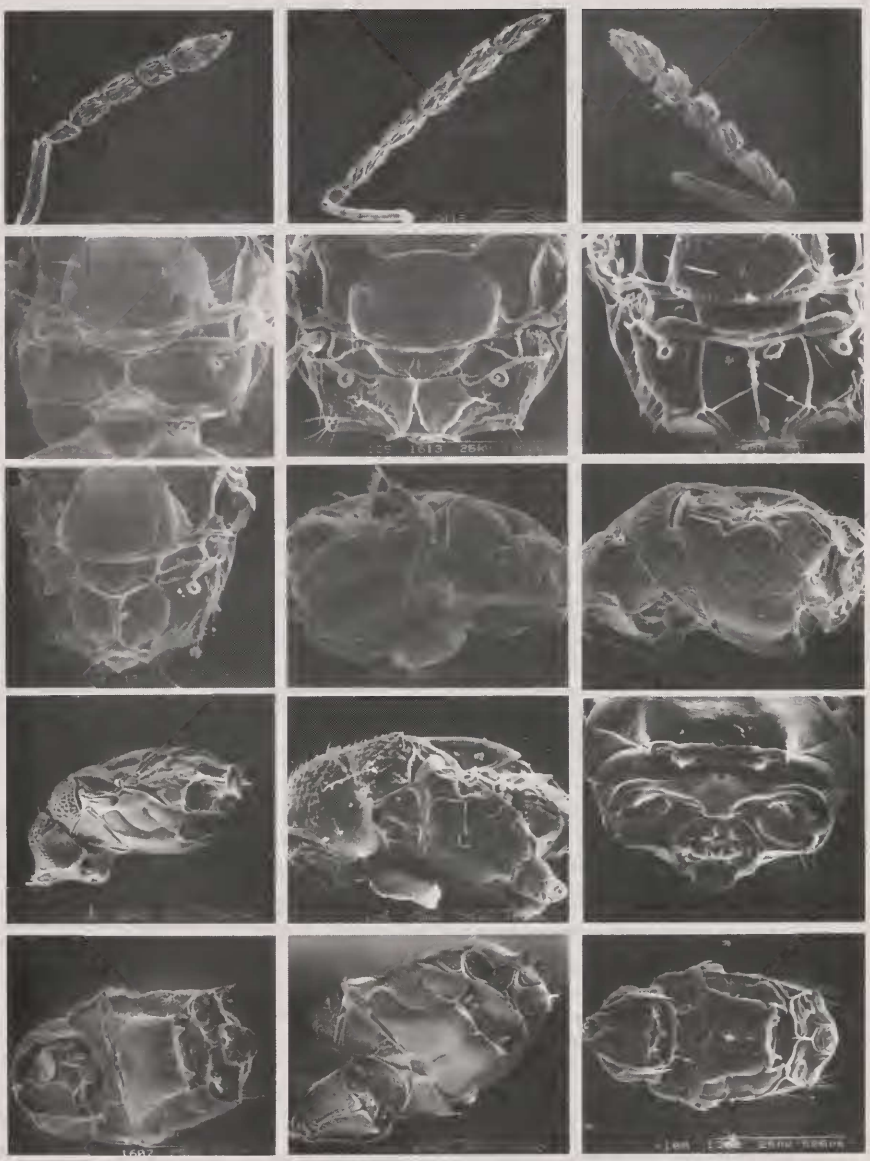
DISCUSSION

Recent comparative morphological study has shown more characters to support close relationship between *Eulophus* and genera mentioned in the introduction of this paper: 1) notauli incomplete; 2) ventral parts of propleuron not closely meeting each other medially till the posterior ends (Fig. 13), posterior margins never forming one straight line (except *Pnigalio* spp); 3) femoral depressions generally present on mesopleuron (except *Pnigalio* spp) (Fig. 9); 4) transepisternal sulcus/groove generally absent, or indistinctly marked by different types of sculpture on upper and lower mesepisternum (except *Pnigalio* spp) (Fig. 9); 5) longitudinal carina(e) generally absent from mesosternum (except *Pnigalio*) (Fig. 13); 6) elongate branches generally present

on male funicle. Recently, we also carried out studies on *Euplectromorpha* (Zhu et Huang 2001) and *Elachertus* (Zhu et Huang, 2001), which genera both belong to Eulophinae (Gauthier 2000). *Elachertus*, *Euplectromorpha* and some other eulophines are quite different from the *Eulophus*-complex, for they have: 1) notauli groove-shaped or carinate, complete to posterior margin of mesoscutum; 2) ventral parts of propleuron meeting each other medially (Fig. 15); 3) acropleural, mesopleural, and transepisternal sulci present on mesopleuron, without femoral depression (Fig. 11); 4) longitudinal carinae present on mesosternum (except *Hyssopus* Girault) (Fig. 15); 5) branches generally absent from funicle; 6) funicle nearly always 4-segmented. With incomplete notauli and branched male funicles, examined species of *Pnigalio* are similar to those in *Eulophus*. However, with straight posterior margin of ventral parts of propleuron, distinct trasepisternal sulcus, longitudinal and transverse carinae on mesosternum, examined species of *Pnigalio* are quite different from those in *Eulophus* and similar to *Elachertus*-complex.

Although thorough investigations have been made to search for more external morphological characters to define *Eulophus*, no more characters have been found yet. We followed Bouček (1959), Schauff et al. (1997) to identify members of *Eulophus* from others.

This study also raised one problem with *Pnigalio* spp. Members of this genus are different from all other Eulophinae by having: 1) distinctly angulated plicae present on propodeum (Fig. 6); 2) transverse costulae generally present between propodeal plicae (Fig. 6); 3) two longitudinal carinae present on ventral part of propodeum (Fig. 14). But they have incomplete notauli and branched funicle like the *Eulophus*-complex. They are also similar to the *Elachertus*-complex as they have characters listed as 2) to 6) of latter. Previously, *Pnigalio* was considered as belonging to the *Eulophus*-complex and being closer to *Sympiesis* (Graham 1959, Bouček 1959, Peck et al. 1964). Recently, Schauff et al. (1997) also placed *Pnigalio* in the *Eulophus*-complex, but it appears to have no closer relationships to any genus in Eulophinae. We wonder if *Pnigalio* is closely related to the *Eulophus*-, *Cirrospilus*-, or *Elachertus*-complexes, and if it is closer to the *Elachertus*-complex. Further extensive SEM study of more material might shed light at *Eulophus*, *Pnigalio* and their relationships to other genera.



Figs. 1-3. antennae: 1. *Eulophus smerinthicida*; 2. *Pnigalio* sp.; 3. *Elachertus* sp. Figs. 4-7. dorsal view of mesosoma: 4. *Cirrospilus* sp.; 5. *Eulophus smerinthicida*; 6. *Pnigalio* sp.; 7. *Elachertus* sp. Figs. 8-11. lateral view of mesosoma: 8. *Cirrospilus* sp.; 9. *Eulophus smerinthicida*; 10. *Pnigalio* sp.; 11. *Elachertus* sp. Figs. 12-15. ventral view of mesosoma: 12. *Aulogymnus elevatus*; 13. *Eulophus smerinthicida*; 14. *Pnigalio* sp.; 15. *Elachertus* sp.

Table 1 – Checklist of World *Eulophus* Geoffroy

Afrotropical Region	
1. *E. senegalensis* Risbec, 1951	Senegal
Australian/Pacific Region	
2. *E. citripes* Ashmead, 1901	Hawaii
Nearctic Region	
3. *E. anomocerus* (Crawford, 1912)	Canada, USA
4. *E. basalis* Say, 1836	USA
5. *E. brevicapitatus* Cook et Davis, 1891	Canada, USA
6. *E. koebelei* (Crawford, 1912)	USA
7. *E. magnisulcatus* Girault, 1916	USA
8. *E. nebulosus* (Provancher, 1887)	Canada, USA
9. *E. neomexicanus* (Girault, 1917)	USA
10. *E. orgyiae* (Fitch, 1856)	USA
11. *E. ramicornis* (Fabricius, 1781)	Canada, USA, China, Switzerland, UK,
Japan,	France, Germany, Sweden*
12. *E. ramosus* Provancher, 1881	Canada, France, Germany, USA, UK
13. *E. smerinthi* (Ashmead, 1898)	USA
Neotropical Region	
14. *E. cemiostomatis* Mann, 1872	Brazil
Oriental Region	
15. *E. femoralis* Zehntner, 1896	Indonesia
16. *E. tardescens* Motschulsky, 1863	Sri Lanka
Palearctic Region	
17. *E. abdominalis* Nees, 1834	Azerbaijan, Czech Republic, Slovakia, Finland, Germany, Hungary, Italy, Netherlands, Poland, Russia, Sweden, UK
18. *E. aepulo* Walker, 1839	UK
19. *E. agathyllus* Walker, 1846	UK
20. *E. albitarsis* Ratzeburg, 1844	France, Germany
21. *E. binotatus* Förster, 1841	Germany
22. *E. blancardellae* Bouché, 1834	Germany
23. *E. boeotus* Walker, 1839	UK
24. *E. breviramulis* Förster, 1841	Germany
25. *E. callidius* Walker, 1839	UK
26. *E. carbo* Walker, 1839	UK
27. *E. cecidomyiarum* Ratzeburg, 1852	Germany
28. *E. cephalotes* Nees, 1834	Germany
29. *E. chrysomelae* Nees, 1834	France, Germany
30. *E. coccorum* Ratzeburg, 1848	Germany
31. *E. crinicornis* Perris, 1841	France
32. *E. cyanescens*, Bouček, 1958	Czech Republic, Slovakia, Moldova, Russia, Sweden
34. *E. depressus* Nees, 1834	Germany
35. *E. dubitabilis* Förster, 1841	Germany
36. *E. emicans* Nees, 1834	Germany
37. *E. entheus* Storozheva, 1981	Russia
38. *E. eucritus* Walker, 1839	UK
39. *E. foveolatus* Nees, 1834	Germany
40. *E. gummiferae* Fairmaire, 1879	Tunisia

*Palearctic regions

41. *E. iapetus* Walker, 1839	UK
42. *E. idrieus* Walker, 1844	Norway
43. *E. inconspicuus* Nees, 1834	Germany
44. *E. kirbyi* Curtis et Westwood, 1826	UK
45. *E. larvarum* (Linnaeus, 1758)	Armenia, Czech Republic, Slovakia, Finland, France, Germany, Hungary, Italy, Japan, Korea, Kyrgyzstan, Moldova, Norway, Portugal, Russia, Sweden, Switzerland, Tajikistan, UK
46. *E. mortuorum* (Rossi, 1792)	Italy
47. *E. nemati* (Blanchard, 1849)	Europe
48. *E. nitidulus* Nees, 1834	Germany
49. *E. orsinus* Walker, 1839	UK
50. *E. pennicornis* Nees, 1834	Austria, Czech Republic, Slovakia, France, Germany, Hungary, Moldova, Poland, Romania, Russia, Sweden, Ukraine, UK.
51. *E. pimpinellae* Rondani, 1874	Italy
52. *E. polycerus* Förster, 1841	Germany
53. *E. pythodorus* Walker, 1848	UK
54. *E. ramicornis* (Fabricius, 1781)	China, Switzerland, UK, Japan, France, Germany, Sweden, Canada, USA **
55. *E. ramosus* Provancher, 1881	France, Germany, UK, Canada, USA **
56. *E. rhamnius* Walker, 1848	UK
57. *E. rupicapra* Förster, 1841	Germany
58. *E. sancus* Walker, 1839	Germany
59. *E. semicupreus* Nees, 1834	Germany
60. *E. slovacus* Bouček, 1959	Czech, Slovakia, Italy, Moldova, Ukraine, Yugoslavia
62. *E. smerinthicida* Bouček, 1959	Austria, Czecho, Slovakia, Georgia, Germany, Japan, Moldova, Russia, Sweden, UK
64. *E. stenostigma* Dufour, 1862	France
65. *E. stygius* Walker, 1848	Sweden
66. *E. tabidus* Nees, 1834	Germany
67. *E. thespius* Walker, 1839	Czech, Slovakia, France, Germany, Hungary, Japan, Mongolia, Netherlands, Sweden, Ukraine, UK
68. *E. trachalus* Walker, 1839	UK
69. *E. tyrrhenus* Walker, 1839	France, UK
70. *E. vagus* Nees, 1834	Germany
71. *E. veturius* Walker, 1848	UK

**Nearctic regions

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